

**Comparing the effect of fluoride containing  
remineralizing agents and Er: YAG laser on enamel  
Demineralization and surface microhardness around  
Orthodontic Brackets (An In vitro study)**

**Thesis**

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## *Dedication*

*This work is humbly dedicated to all my valuable treasures in life:*

*To my wonderful mother and father who are always there for me, giving me the strength to carry on.*

*I don't know what I would have done without you.*

*To my loving husband Mohamed, for his patient, love, friendship, humor and willingness to eat out.*

*Love him endless thanks and gratitude.*

*To my adorable son Amr for giving me this kind of love that people freely die for.*

*I wish I make you proud of me someday.*

*To my lovely sisters Amal and Amira*

*To my brother Mohamed my backbone and lifetime supporter*

*To my gorgeous nieces Hajer, Mayar, Mariam, Lamar and Celia.*

*To my mother, father and sister in law.*

*And at last but not the least to my dearest friends and colleagues.*

وَمَا تَوْفِيقِي إِلَّا بِاللَّهِ  
عَلَيْهِ تَوَكَّلْتُ وَإِلَيْهِ أُنِيبُ

سورة هود ، آية 88

# LIST OF CONTENT

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<b>Title</b>	<b>Page no.</b>
• List of abbreviations .....	I
• List of tables .....	IV
• List of figures .....	V
• Introduction .....	1
• Review of Literature .....	3
• Aim of the Study .....	28
• Materials and Methods .....	29
• Results .....	42
• Discussion .....	59
• Summary .....	67
• Conclusion .....	70
• Recommendation .....	71
• References .....	72

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## LIST OF ABBREVIATION

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<b>Abbreviation</b>	<b>Abbreviation for</b>
<b>WSLs</b>	White Spot Lesions
<b>Er: YAG</b>	Erbium-doped Yttrium Aluminium Garnet
<b>Er, Cr: YSGG</b>	Erbium, Chromium: Yttrium Scandium Gallium Garnet
<b>%</b>	Percentage
<b>NaF</b>	Sodium Fluoride
<b>fTCP</b>	Functional Tricalcium Phosphate
<b>HA</b>	Hydroxyapatite
<b>Ca</b>	Calcium
<b>PO<sub>4</sub></b>	Phosphate
<b>OH</b>	Hydroxyl group
<b>FA</b>	Fluorapatite
<b>CaF<sub>2</sub></b>	Calcium Fluoride
<b>CaF<sup>+</sup></b>	Bound Calcium Fluoride
<b>α-TCP</b> <b>Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub></b>	Tricalcium Phosphate
<b>CPP-ACP</b>	Casein PhosphoPeptide- Amorphous Calcium Phosphate
<b>ACP</b>	Amorphous Calcium Phosphate

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## LIST OF ABBREVIATION (Cont.....)

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<b>Abbreviation</b>	<b>Abbreviation for</b>
<b>CO<sub>2</sub> laser</b>	Carbon dioxide laser
<b>US</b>	United State
<b>FDA</b>	Food and Drug Administration
<b>µm</b>	Micrometer
<b>nm</b>	Nanometer
<b>ERL</b>	Er: YAG Lasers
<b>micro-CT</b>	micro-Computed Tomography
<b>LICP</b>	Laser-Induced Caries Prevention
<b>SMH</b>	Surface Microhardness
<b>PLM</b>	Polarized Light Microscope
<b>SEM</b>	Scanning Electron Microscopy
<b>°c</b>	Celsius degree
<b>S</b>	Second
<b>Mm</b>	Millimeter
<b>CaCl<sub>2</sub></b>	Calcium Chloride
<b>NaHCO<sub>3</sub></b>	Sodium Bicarbonate



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## LIST OF ABBREVIATION (Cont.....)

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<b>Abbreviation</b>	<b>Abbreviation for</b>
<b>NaH<sub>2</sub>PO<sub>4</sub></b>	Sodium Phosphate monobasic
<b>mmol/L</b>	Millimole per liter
<b>Hz</b>	Hertz
<b>mJ</b>	Millijoule
<b>μs</b>	Microsecond
<b>g</b>	Gram
<b>HV</b>	Vickers Hardness
<b>ANOVA</b>	Analysis of Variance
<b>SPSS- V17</b>	Statistical Package for the Social Sciences Version 2017
<b>SD</b>	Standard Deviation

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## LIST OF TABLES

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<b>Table no</b>	<b>Title</b>	<b>Page no</b>
<b>Table (1):</b>	Materials used	<b>29</b>
<b>Table (2):</b>	Sample grouping	<b>34</b>
<b>Table (3):</b>	Multiple comparisons of surface microhardness values of specimens after 14 days	<b>42</b>
<b>Table (4):</b>	Multiple comparisons of surface microhardness values of specimens after 28 days	<b>44</b>
<b>Table (5):</b>	T-Test between surface microhardness values of the control group after 14 and 28 days	<b>46</b>
<b>Table (6):</b>	T-Test between surface microhardness values of the TCP group after 14 and 28 days	<b>47</b>
<b>Table (7):</b>	T-Test between surface microhardness values of the NaF group after 14 and 28 days	<b>48</b>
<b>Table (8):</b>	T-Test between surface microhardness values of the Er: YAG group after 14 and 28 days	<b>48</b>
<b>Table (9):</b>	Multiple comparisons of lesion depth measurements of specimens after 14 days	<b>49</b>
<b>Table (10):</b>	Multiple comparisons of lesion depth measurements of specimens after 28 days	<b>51</b>
<b>Table (11):</b>	T-Test between lesion depth measurements of the control group after 14 and 28 days	<b>53</b>
<b>Table (12):</b>	T-Test between lesion depth measurements of the TCP group after 14 and 28 days	<b>54</b>
<b>Table (13):</b>	T-Test between lesion depth measurements of the NaF group after 14 and 28 days	<b>54</b>
<b>Table (14):</b>	TUKEY'S Test between lesion depth measurements of the Er: YAG group after 14 and 28 days	<b>55</b>
<b>Table (15):</b>	Percentage of lesion depth change	<b>56</b>

---

## LIST OF FIGURES

---

<b>Fig. no.</b>	<b>Title</b>	<b>Page no.</b>
<b>Fig. (1):</b>	TCP varnish (3M ESPE Clinpro™ white varnish)	<b>29</b>
<b>Fig. (2):</b>	Sodium fluoride varnish (Voco Bifluoride 10™)	<b>29</b>
<b>Fig. (3):</b>	Sound premolars before bonding of orthodontic brackets	<b>31</b>
<b>Fig. (4):</b>	0.1% Thymol solution- Deionzed water	<b>32</b>
<b>Fig. (5):</b>	Sound premolars after bonding of orthodontic brackets- adhesive tap with a hole	<b>32</b>
<b>Fig. (6):</b>	Bonding agent	<b>33</b>
<b>Fig. (7):</b>	Plastic mold-acrylic resin-tooth in acrylic block	<b>34</b>
<b>Fig. (8):</b>	Er: YAG laser Key laser 1242 and mirror hand piece 2060	<b>35</b>
<b>Fig. (9):</b>	Er: YAG laser exposure, Application of TCP varnish and Application of NaF varnish	<b>35</b>
<b>Fig. (10):</b>	Artificial saliva, remineralizing solution and remineralizing solution	<b>36</b>
<b>Fig. (11):</b>	Separate bakers of remineralizing solution	<b>37</b>
<b>Fig. (12):</b>	Separate bakers of demineralizing solution	<b>37</b>

---

## LIST OF FIGURES (Cont....)

---

Fig. no.	Title	Page no.
<b>Fig(13):</b>	Isomet low speed saw	<b>39</b>
<b>Fig. (14):</b>	Wilson Hardness Vicker tester, Buehler, USA	<b>39</b>
<b>Fig. (15):</b>	Polarized Light Microscope	<b>41</b>
<b>Fig. (16):</b>	Bar chart: Multiple comparisons of surface microhardness of subgroups 2 after 14 days	<b>43</b>
<b>Fig. (17):</b>	Bar chart: Multiple comparisons of surface microhardness of subgroup 2 after 28 days	<b>45</b>
<b>Fig. (18):</b>	Bar chart: T-Test between surface microhardness of group A (control) after 14 and 28 days	<b>46</b>
<b>Fig. (19):</b>	Bar chart: T-Test between surface microhardness of group B (TCP) after 14 and 28 days	<b>47</b>
<b>Fig. (20):</b>	Bar chart: T-Test between surface microhardness of group C (NaF) after 14 and 28 days	<b>48</b>
<b>Fig. (21):</b>	Bar chart: T-Test between surface microhardness of group D (Er: YAG) after 14 and 28 days	<b>49</b>
<b>Fig. (22):</b>	Bar chart: Multiple comparisons of lesion depth of subgroup 1 after 14 days	<b>50</b>
<b>Fig. (23):</b>	Bar chart: Multiple comparisons of lesion depth of subgroup 2 after 28 days	<b>51</b>
<b>Fig. (24):</b>	Bar chart: T-Test between lesion depth of group A (control ) after 14 and 28 days	<b>53</b>
<b>Fig. (25):</b>	Bar chart: T-Test between lesion depth of group B (TCP ) after 14 and 28 days	<b>54</b>

---

## LIST OF FIGURES (Cont....)

---

<b>Fig. no.</b>	<b>Title</b>	<b>Page no.</b>
<b>Fig. (26):</b>	Bar chart: T-Test between lesion depth of group C (NaF) after 14 and 28 days	<b>55</b>
<b>Fig. (27):</b>	Bar chart: T-Test between lesion depth of group D (Er:YAG) after 14 and 28 days	<b>56</b>
<b>Fig. (28):</b>	Polarized light microscopy image of representative lesion from group A (control) after 14 days	<b>57</b>
<b>Fig. (29):</b>	Polarized light microscopy image of representative lesion from group B (TCP) after 14 days	<b>57</b>
<b>Fig. (30):</b>	Polarized light microscopy image of representative lesion from group C (NaF) after 14 days	<b>57</b>
<b>Fig. (31):</b>	Polarized light microscopy image of representative lesion from group D (Er: YAG) after 14 days	<b>57</b>
<b>Fig. (32):</b>	Polarized light microscopy image of representative lesion from group A (control) after 28 days	<b>58</b>
<b>Fig. (33):</b>	Polarized light microscopy image of representative lesion from group B (TCP) after 28 days	<b>58</b>
<b>Fig. (34):</b>	Polarized light microscopy image of representative lesion from group C (NaF) after 28 days	<b>58</b>
<b>Fig. (35):</b>	Polarized light microscopy image of representative lesion from group D (Er: YAG) after 28 days	<b>58</b>

## **Introduction**

Enamel demineralization is particularly common problem during orthodontic treatment, and its treatment is one of the greatest challenges faced by clinicians. The presence of fixed appliances on tooth surfaces with brackets and bands makes it difficult to clean teeth, favor dental biofilm accumulation, in addition to increasing the prevalence of cariogenic bacteria.<sup>1</sup>

Clinically, the demineralization sites are detected as opaque and porous white spot lesions (WSLs) that may compromise the final result of orthodontic treatment. Enamel demineralization around orthodontic brackets may be due to acid etching during bonding of brackets, cariogenic and sticky food, accumulation of food around brackets and bad oral hygiene.<sup>2</sup>

WSL is considered irreversible process of the tooth surfaces loss, so prevention of demineralization is extremely important during orthodontic treatment.<sup>3,4</sup>

The risk of enamel demineralization can be prevented or reduced with various conventional methods including the application of remineralizing agents and different forms of fluoride treatments as well as contemporary treatments like laser irradiation. The most frequent method used in clinical practice today is the application of fluoride agents in various forms, which is a proven approach for promoting enamel remineralization.<sup>5,6,7</sup>

Laser technology can be used in soft tissue surgery, caries prevention, caries diagnosis, cavity preparation, and endodontic treatment for children. Caries prevention procedures have used different laser systems such as Er:

YAG (Erbium-doped yttrium aluminium garnet) and Er, Cr: YSGG (erbium, chromium: yttrium scandium gallium garnet).<sup>8</sup>

It was reported that caries prevention provided by the one-time initial laser treatment to be comparable to daily fluoride treatment by a fluoride dentifrice.<sup>9</sup>

In recent years, researchers have tended to agree that fluoride varnishes offer an effective means of not only preventing caries, but also arresting early enamel lesions.<sup>10,11,12</sup>

The clinical effects of fluorides depend on the chemical compounds utilized and the methods used to apply the fluoride ion to the surface of the tooth.<sup>13</sup>

Of the different concentrations and forms of fluoride used in varnishes, 5% of sodium fluoride (NaF) had emerged as one of the most popular form of fluoride varnish. Recently, a white 5% NaF varnish containing functional tricalcium phosphate (fTCP) has been introduced in the market (ClinproWhite varnish).<sup>14,15</sup>